PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : A43B 13/00	A1	(11) International Publication Number: WO 91/11124 (43) International Publication Date: 8 August 1991 (08.08.91)

(21) International Application Number: PCT/US91/00374

(22) International Filing Date: 24 January 1991 (24.01.91)

(30) Priority data:
469,313 24 January 1990 (24.01.90) US

(71)(72) Applicant and Inventor: ELLIS, Frampton, E., III [US/US]; 2895 South Abington Street, Suite B-2, Arlington, VA 22206 (US).

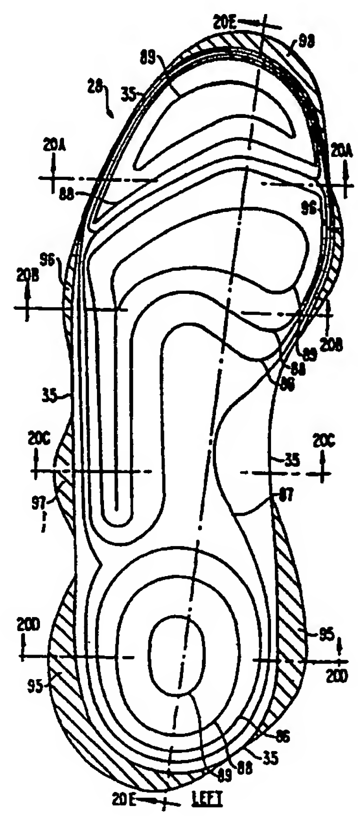
(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.

(54) Title: SHOE SOLE STRUCTURES USING A THEORETICALLY IDEAL STABILITY PLANE

(57) Abstract

A construction for a shoe, particularly an athletic shoe such as a running shoe (20) includes a sole (22) that is constructed according to applicant's definition of a theoretically ideal stability plane (51). Such a shoe sole according to that definition conforms to the natural shape of the foot, particularly the sides, and that has a constant thickness (S) in frontal plane cross sections; the thickness (S) of the shoe sole sides contour equals and therefore varies exactly as the thickness of the load-bearing sole portion (28b). The invention relates to the use of the theoretically ideal stability plane concept to provide natural stability in negative heel shoe soles that are less thick in the heel area than in the rest of the shoe sole (28, fig. 8). This invention also relates to the use of the theoretically ideal stability plane concept to provide natural stability in flat shoe soles that have no heel lift (28, fig. 9) maintaining the same thickness throughout; such a design avoids excessive structural rigidity by using contoured stability sides abbreviated to only essential structural support elements (95-98, fig. 9D) to provide the shoe sole with natural flexibility paralleling that of the human foot. The abbreviation of essential structural support elements (95-98, fig. 9D) can also be applied to negative heel shoe soles (28, fig. 8) again to avoid excessive rigidity and to provide natural flexibility.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark				

SHOE SOLE STRUCTURES USING A THEORETICALLY IDEAL STABILITY PLANE

BACKGROUND OF THE INVENTION

This invention relates generally to the structure of shoes. More specifically, this invention relates to the structure of athletic shoes. Still more particularly, this invention relates to variations in the structure of such shoes using the applicant's prior invention of a theoretically-ideal stability plane as a basic concept. Still more particularly, this invention relates to the use of the theoretically ideal stability plane concept to provide stability in negative heel shoe soles that are less thick in the heel area than in the rest of the shoe sole. Still more particularly, this invention also relates to the use of the theoretically ideal stability plane concept to provide natural stability in flat shoe soles that have no heel lift, thereby maintaining the same thickness throughout; excessive structural rigidity being avoided with contoured stability sides abbreviated to only essential structural support elements to provide the shoe sole with natural flexibility paralleling that of the human foot.

The applicant has introduced into the art the general concept of a theoretically ideal stability plane as a structural basis for shoe designs. That concept as implemented into shoes such as street shoes and athletic shoes is presented in pending U.S. applications Nos. 07/219,387, filed on July 15, 1988; 07/239,667, filed on September 2, 1988; 07/400,714, filed on August 30, 1989; 07/416,478, filed on October 3, 1989, and 07/424,509, filed October 20, 1989, as well as in PCT Application No. PCT/US89/03076 filed on July 14, 1989. This application develops the application of the concept of the theoretically ideal stability plane to other shoe structures.

The purpose of the theoretically ideal stability plane as described in these pending applications was primarily to provide a neutral design that allows for natural foot and ankle biomechanics as close as possible to that between the foot and the ground, and to avoid the serious interference with natural foot and ankle biomechanics inherent in existing shoes.

In its most general form, the concept of the theoretically ideal stability plane is that the thickness of contoured stability sides of shoe soles, typically measured in the frontal plane, should equal the thickness of the shoe sole underneath the foot. The pending applications listed above all use figures which show that concept applied to embodiments of shoe soles with heel lifts, since that feature is standard to almost all shoes. Moreover, the variation in the sagittal plane thickness caused by the heel lifts of those embodiments is one of the primary elements in the originality of the invention.

However, the theoretically ideal stability plane concept is more general than those specific prior embodiments. It is clear that the concept would apply just as effectively to shoes with unconventional sagittal plane variations, such as negative heel shoe soles, which are less thick in the heel than the forefoot. Such shoes are not common: the only such shoe with even temporarily widespread commercial success was the Earth Shoe, which has not been produced since the mid-1970's.

The lack of success of such shoes may well have been due to problems unrelated to the negative heel. For example, the sole of the Earth Shoe was constructed of a material that was so firm that there was almost no forefoot flexibility in the plane, as is normally required to accommodate the human foot's flexibility there; in addition, the Earth Shoe sole was contoured to fit the natural shape of the wearer's load-bearing foot

sole, but the rigid sole exaggerated any inexactness of fit between the wearer and the standard shoe size.

In contrast, a properly constructed negative heel shoe sole may well have considerable value in compensating for the effect of the long term adverse effect of conventional shoes with heel lifts, such as high heel shoes. Consequently, effectively designed negative heel shoe soles could become more widespread in the future and, if so, their stability would be significantly improved by incorporating the theoretically ideal stability plane concept that is the basis of the applicant's prior inventions.

The stability of flat shoe soles that have no heel lift, maintaining the same thickness throughout, would also be greatly improved by the application of the same theoretically ideal plane concept.

For the very simplest form of shoe sole, that of a Indian moccasin of single or double sole, the standard test of originally would obviously preclude any claims of new invention. However, that simple design is severely limited in that it is only practical with very thin soles. With sole thickness that is typical, for example, of an athletic shoe, the moccasin design would have virtually no forefoot flexibility, and would obstruct that of the foot.

The inherent problem of the moccasin design is that the U shape of the moccasin sole in the frontal plane creates a composite sagittal plane structure similar to a simple support beam designed for rigidity; the result is that any moccasin which is thick soled is consequently highly rigid in the horizontal plane.

The applicant's prior application No. 07/239,667, filed on September 2, 1988, includes an element to counteract such unnatural rigidity: abbreviation of the contoured stability sides of the shoe sole to only essential structural support and propulsion elements. The essential structural support elements are

the base and lateral tuberosity of the calcaneus, the heads of the metatarsals, and the base of the fifth metatarsal. The essential propulsion element is the head of the first distal phalange.

Abbreviation of the contoured sides of the shoe sole to only essential structural elements constitutes an original approach to providing natural flexibility to the double sole moccasin design, overcoming its inherent limitation of thin soles. As a result, it is possible to construct naturally stable shoe soles that are relatively thick as is conventional to provide good cushioning, particularly for athletic and walking shoes, and those shoe soles can be natural in the fullest sense; that is, without any unnatural heel lift, which is, of course, an invention dating from the Sixteenth Century.

Consequently, a flat shoe sole with abbreviated contour sides would be the most neutral design allowing for natural foot and ankle biomechanics as close as possible to that between the foot and the ground and would avoid the serious interference with natural foot and ankle biomechanics inherent in existing shoes. Such a shoe sole would have uniform thickness in the sagittal plane, not just the frontal plane.

Accordingly, it is a general object of this invention to elaborate upon the application of the principle of the theoretically ideal stability plane to other shoe structures.

It is another general object of this invention to provide a shoe sole which applies the theoretically ideal stability plane concept to provide natural stability to negative heel shoe soles that are less thick in the heel area than in the rest of the shoe sole.

It is still another object of this invention to provide a shoe sole which applies the theoretically ideal stability plane concept to flat shoe soles that have no heel lift, maintaining the same thickness throughout; excessive structural rigidity being avoided with

contoured stability sides abbreviated to only essential structural support elements to provide the shoe sole with natural flexibility paralleling that of the human foot.

It is still another object of this invention to provide a shoe sole wherein the abbreviation of essential structural support elements can also be applied to negative heel shoe soles, again to avoid excessive rigidity and to provide natural flexibility.

These and other objects of the invention will become apparent from a detailed description of the invention which follows taken with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a perspective view of a typical running shoe known to the prior art to which the invention is applicable.

Fig. 2 shows, in frontal plane cross section at the heel portion of a shoe, the applicant's prior invention of a shoe sole with naturally contoured sides based on a theoretically ideal stability plane.

Fig. 3 shows, again in frontal plane cross section, the most general case of the applicant's prior invention, a fully contoured shoe sole that follows the natural contour of the bottom of the foot as well as its sides, also based on the theoretically ideal stability plane.

Fig. 4 shows, again in frontal plane cross section of the metatarsal or forefoot arch, an intermediate case of the applicant's prior invention, between those shown in Figs. 3 and 4, wherein the naturally contoured sides design is extended to the other natural contours underneath the load-bearing foot; such contours include the main longitudinal arch.

Fig. 5 shows in top view the applicant's prior invention of abbreviation of contoured sides to only

essential structural support and propulsion elements (shown hatched), as applied to the fully contoured design shown in Fig. 3.

Fig. 6, as seen in FIGS. 6A to 6C in frontal plane cross section at the heel, shows the applicant's prior invention for conventional shoes, a quadrant-sided shoe sole, based on a theoretically ideal stability plane.

Fig. 7 shows the applicant's new invention of the use of the theoretically ideal stability plane concept applied to a negative heel shoe sole that is less thick in the heel area than in the rest of the shoe sole. Fig. 7A is a cross sectional view of the forefoot portion taken along lines 7A of Fig. 7D; Fig. 7B is a view taken along lines 7B of Fig. 7D; Fig. 7C is a view taken along the heel along lines 7C in Fig. 7D; and Fig. 7D is a top view of the shoe sole with the thicker forefoot section shown hatched.

Fig. 8 shows, in Figs. 8A-8D, a plurality of side sagittal plane cross sectional views of examples of negative heel sole thickness variations to which the general approach shown in Fig. 7 can be applied; Fig. 8A shows the same embodiment as Fig. 7.

Fig. 9 shows the applicant's other new invention of the use of the theoretically ideal stability plane concept applied to a flat shoe sole that have no heel lift, maintaining the same thickness throughout, with contoured stability sides abbreviated to only essential structural support elements. Fig. 9A is a cross sectional view of the forefoot portion taken along lines 9A of Fig. 9D; Fig. 9B is a view taken along lines 9B of Fig. 9D; Fig. 9C is a view taken along the heel along lines 9C in Fig. 9D; Fig. 9D is a top view of the shoe sole with the sides that are abbreviated to essential structural support elements shown hatched; and Fig. 9E is a sagittal plane cross section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 is a perspective view of an athletic shoe, such as a typical running shoe, according to the prior art, wherein a running shoe 20 includes an upper portion 21 and a sole 22.

Figs. 2, 3, and 4 show frontal plane cross sectional views of a shoe sole according to the applicant's prior inventions based on the theoretically ideal stability plane, taken at about the ankle joint to show the heel section of the shoe. In the figures, a foot 27 is positioned in a naturally contoured shoe having an upper 21 and a sole 28. The concept of the theoretically ideal stability plane, as developed in the prior applications as noted, defines the plane 51 in terms of a locus of points determined by the thickness (s) of the sole. The reference numerals are like those used in the prior pending applications of the applicant mentioned above and which are incorporated by reference for the sake of completeness of disclosure, if necessary.

Fig. 2 shows, in a rear cross sectional view, the application of the prior invention, described in pending U.S. application No. 07/239,667, showing the inner surface of the shoe sole conforming to the natural contour of the load-bearing foot and the thickness of the shoe sole remaining constant in the frontal plane, so that the outer surface coincides with the theoretically ideal stability plane. In other words, the outer surface parallels the inner surface in the frontal plane.

Fig. 3 shows a fully contoured shoe sole design of the applicant's prior invention, described in the same pending application, that follows the natural contour of all of the foot, the bottom as well as the sides, while retaining a constant shoe sole thickness in the frontal plane; again, the inner surface of the shoe sole that conforms to the shape of the foot is paralleled in the frontal plane by the outer surface of the bottom sole.

The fully contoured shoe sole assumes that the resulting slightly rounded bottom when unloaded will deform under load and flatten just as the human foot bottom is slightly rounded unloaded but flattens under load; therefore, shoe sole material must be of such composition as to allow the natural deformation following that of the foot. The design applies particularly to the heel, but to the rest of the shoe sole as well. By providing the closest match to the natural shape of the foot, the fully contoured design allows the foot to function as naturally as possible. Under load, Fig. 3 would deform by flattening to look essentially like Fig. 2. Seen in this light, the naturally contoured side design in Fig. 2 is a more conventional, conservative design that is a special case of the more general fully contoured design in Fig. 3, which is the closest to the natural form of the foot, but the least conventional. The amount of deformation flattening used in the Fig. 2 design, which obviously varies under different loads, is not an essential element of the applicant's invention.

Figs. 2 and 3 both show in frontal plane cross sections the essential concept underlying this invention, the theoretically ideal stability plane, which is also theoretically ideal for efficient natural motion of all kinds, including running, jogging or walking. Fig. 3 shows the most general case of the invention, the fully contoured design, which conforms to the natural shape of the unloaded foot. For any given individual, the theoretically ideal stability plane 51 is determined, first, by the desired shoe sole thickness (s) in a frontal plane cross section, and, second, by the natural shape of the individual's foot surface 29.

For the special case shown in Fig. 2, the theoretically ideal stability plane for any particular individual (or size average of individuals) is determined, first, by the given frontal plane cross section shoe sole thickness (s); second, by the natural

shape of the individual's foot; and, third, by the frontal plane cross section width of the individual's load-bearing footprint 30b, which is defined as the upper surface of the shoe sole that is in physical contact with and supports the human foot sole.

The theoretically ideal stability plane for the special case is composed conceptually of two parts. Shown in Fig. 2, the first part is a line segment 31b of equal length and parallel to line 30b at a constant distance (s) equal to shoe sole thickness. This corresponds to a conventional shoe sole directly underneath the human foot, and also corresponds to the flattened portion of the bottom of the load-bearing foot sole 28b. The second part is the naturally contoured stability side outer edge 31a located at each side of the first part, line segment 31b. Each point on the contoured side outer edge 31a is located at a distance which is exactly shoe sole thickness (s) from the closest point on the contoured side inner edge 30a.

In summary, the theoretically ideal stability plane is the essence of the applicant's prior invention because it is used to determine a geometrically precise bottom contour of the shoe sole based on a top contour that conforms to the contour of the foot. This prior invention specifically claims the exactly determined geometric relationship just described.

It can be stated unequivocally that any shoe sole contour, even of similar contour, that exceeds the theoretically ideal stability plane will restrict natural foot motion, while any less than that plane will degrade natural stability, in direct proportion to the amount of the deviation. The theoretical ideal was taken to be that which is closest to natural.

Figs. 4, also described in pending U.S. application No. 07/239,667, illustrates in frontal plane cross section the naturally contoured sides design extended to the other natural contours underneath the

load-bearing foot; the metatarsal or forefoot arch is shown, but other such underneath contours include the main longitudinal arch and the ridge between the heads of the distal phalanges (toes).

Fig. 5 shows the applicant's prior invention of contour sides abbreviated to essential structural elements, also described in pending U.S. application No. 07/239,667, as applied to the fully contoured design of Fig. 3. Fig. 5 shows the horizontal plane top view of fully contoured shoe sole of the left foot abbreviated along the sides to only essential structural support and propulsion elements (shown hatched). Shoe sole material density can be increased in the unabbreviated essential elements to compensate for increased pressure loading there. The essential structural support elements are the base and lateral tuberosity of the calcaneus 95, the heads of the metatarsals 96, and base of the fifth metatarsal 97. They must be supported both underneath and to the outside for stability. The essential propulsion element is the head of the first distal phalange 98. The medial (inside) and lateral (outside) sides supporting the base of the calcaneus are shown in Fig. 5 oriented along either side of the horizontal plane subtalar ankle joint axis, but can be located also more conventionally along the longitudinal axis of the shoe sole. Fig. 5 shows that the naturally contoured stability sides need not be used except in the identified essential areas. Weight savings and flexibility improvements can be made by omitting the non-essential stability sides. Contour lines 85 through 89 show approximately the relative height of the shoe sole contours within roughly the peripheral extent 36 of the undeformed load-bearing shoe sole 28b. A horizontal plane bottom view (not shown) of Fig. 5 would be the exact reciprocal or converse of Fig. 5 with the peaks and valleys contours exactly reversed.

Fig. 6 illustrates in frontal plane cross section a final variation of the applicant's prior invention, described in pending U.S. application No. 07/219,387, that uses stabilizing quadrants 26 at the outer edge of a conventional shoe sole 28b illustrated generally at the reference numeral 28. The stabilizing quadrants would be abbreviated in actual embodiments as shown in FIGS. 6B and 6D.

Fig. 7 shows the applicant's new invention of using the theoretically ideal stability plane concept to provide natural stability in negative heel shoe soles that are less thick in the heel area than in the rest of the shoe sole; specifically, a negative heel version of the naturally contoured sides conforming to a load-bearing foot design shown in Fig. 2.

Figs. 7A, 7B and 7C represent frontal plane cross sections taken along the forefoot, at the base of the fifth metatarsal, and at the heel, thus illustrating that the shoe sole thickness is constant at each frontal plane cross section, even though that thickness varies from front to back, due to the sagittal plane variation 38 (shown hatched) causing a lower heel than forefoot, and that the thickness of the naturally contoured sides is equal to the shoe sole thickness in each Fig. 7A-7C cross section. Moreover, in Fig. 7D, a horizontal plane overview or top view of the left foot sole, it can be seen that the horizontal contour of the sole follows the preferred principle in matching, as nearly as practical, the rough footprint of the load-bearing foot sole.

The abbreviation of essential structural support elements can also be applied to negative heel shoe soles such as that shown in Fig. 7 and dramatically improves their flexibility. Negative heel shoe soles such as Fig. 7 can also be modified by any of the applicant's prior inventions described in pending U.S. applications Nos. 07/219,387, filed on July 15, 1988; 07/239,667, filed on September 2, 1988; 07/400,714, filed

on August 30, 1989; 07/416,478, filed on October 3, 1989, and 07/424,509, filed October 20, 1989

Fig. 8 shows, in Figs. 8A-8D, possible sagittal plane shoe sole thickness variations for negative heel shoes. The hatched areas indicate the forefoot lift or wedge 38. At each point along the shoe soles seen in sagittal plane cross sections, the thickness varies as shown in Figs. 8A-8D, while the thickness of the naturally contoured sides 28a, as measured in the frontal plane, equal and therefore vary directly with those sagittal plane thickness variations. Fig. 8A shows the same embodiment as Fig. 7.

Fig. 9 shows the applicant's new invention of using the theoretically ideal stability plane concept to provide natural stability in flat shoe soles that have no heel lift, maintaining the same thickness throughout, with contoured stability sides abbreviated to only essential structural support elements to provide the shoe sole with natural flexibility paralleling that of the human foot.

Figs. 9A, 9B and 9C represent frontal plane cross sections taken along the forefoot, at the base of the fifth metatarsal, and at the heel, thus illustrating that the shoe sole thickness is constant at each frontal plane cross section, while constant in the sagittal plane from front to back, so that the heel and forefoot have the same shoe sole thickness, and that the thickness of the naturally contoured sides is equal to the shoe sole thickness in each Fig. 9A-9C cross section. Moreover, in Fig. 9D, a horizontal plane overview or top view of the left foot sole, it can be seen that the horizontal contour of the sole follows the preferred principle in matching, as nearly as practical, the rough footprint of the load-bearing foot sole. Fig. 9E, a sagittal plane cross section, shows that shoe sole thickness is constant in that plane.

Fig. 9 shows the applicant's prior invention of contour sides abbreviated to essential structural elements, as applied to a flat shoe sole. Fig. 9 shows the horizontal plane top view of fully contoured shoe sole of the left foot abbreviated along the sides to only essential structural support and propulsion elements (shown hatched). Shoe sole material density can be increased in the unabbreviated essential elements to compensate for increased pressure loading there. The essential structural support elements are the base and lateral tuberosity of the calcaneus 95, the heads of the metatarsals 96, and base of the fifth metatarsal 97. They must be supported both underneath and to the outside for stability. The essential propulsion element is the head of the first distal phalange 98. The medial (inside) and lateral (outside) sides supporting the base and lateral tuberosity of the calcaneus are shown in Fig. 9 oriented in a conventional way along the longitudinal axis of the shoe sole, in order to provide direct structural support to the base and lateral tuberosity of the calcaneus, but can be located also along either side of the horizontal plane subtalar ankle joint axis . Fig. 9 shows that the naturally contoured stability sides need not be used except in the identified essential areas. Weight savings and flexibility improvements can be made by omitting the non-essential stability sides. A horizontal plane bottom view (not shown) of Fig. 9 would be the exact reciprocal or converse of Fig. 9 with the peaks and valleys contours exactly reversed.

Flat shoe soles such as Fig. 9 can also be modified by any of the applicant's prior inventions described in pending U.S. applications Nos. 07/219,387, filed on July 15, 1988; 07/239,667, filed on September 2, 1988; 07/400,714, filed on August 30, 1989; 07/416,478, filed on October 3, 1989, and 07/424,509, filed October 20, 1989

WHAT IS CLAIMED IS:

1. A shoe sole construction for a shoe, such as a street shoe or athletic shoe comprising:

a sole having a substantially flat sole portion including a foot support surface, a naturally contoured side portion merging with at least a side of the forefoot portion of the said sole portion and conforming substantially to the shape of the associated sides of the human foot sole, and a substantially uniform frontal plane thickness;

said thickness being defined as about the shortest distance between any point on about an upper foot-contacting surface of said shoe sole and about a lower, ground-contacting surface;

said thickness varying in about the sagittal plane and being greater in the forefoot portion than in the heel portion;

said thickness of the naturally contoured side portion about equaling and therefore varying substantially directly with the thickness of the sole portion in about the frontal plane.

2. The shoe sole construction as set forth in claim 1 wherein said naturally contoured side portion extends to at least one of the natural contours underneath the load-bearing foot.

3. The shoe sole construction as set forth in claim 1 wherein at least a forefoot portion of said shoe sole will deform under load and flatten about just does the human foot under load and wherein the material of said shoe sole is of such composition as to allow natural deformation about following that of the foot.

4. The shoe sole construction as set forth in claim 1 wherein approximately freely articulating joints are formed in the shoe sole that parallel those in the foot be removing part or nearly all material of said sole portion between the heel and the forefoot, except under one of the essential structural support elements, the bases of the fifth metatarsal, and except for an upper connecting layer of fabric or thin flexible top sole.

5. The shoe sole construction as set forth in claim 1 wherein an optional shoe sole support for the main longitudinal arch is retained.

6. The shoe sole construction as set forth in claim 1 wherein the forefoot is subdivided into some or all of its component essential structural support and propulsion elements, the individual heads of the metatarsals and the heads of the distal phalanges.

7. The shoe sole construction as set forth in claim 1 wherein said shoe sole includes one or more frontal plane slits through most or nearly all of said shoe sole.

8. The shoe sole construction as set forth in claim 1 wherein said naturally contoured side portion is substantially abbreviated along its sides to a plurality of essential support and propulsion elements, which include the base and lateral tuberosity of the calcaneus, the heads of the metatarsals, the base of the fifth metatarsal, and the head of the first distal phalange.

9. A shoe sole construction for a shoe, such as a street or athletic shoe, comprising:

a shoe sole that conforms substantially to the natural shape of the wearer's foot sole, including portions of its sides, and that has a substantially constant thickness in about frontal plane cross sections,

said thickness being defined as about the shortest distance between any point on about the upper foot contacting surface of said shoe sole and about a lower ground-contacting surface,

said thickness varying in about the sagittal plane and said shoe sole including a forefoot portion with said thickness that is greater than a heel portion.

10. The shoe sole construction as set forth in claim 9 wherein at least a forefoot portion of said shoe sole will deform under load and flatten about just does the human foot under load and wherein the material of said shoe sole is of such composition as to allow natural deformation about following that of the foot.

11. The shoe sole construction as set forth in claim 9 wherein approximately freely articulating joints are formed in the shoe sole that parallel those in the foot be removing part or nearly all material of said sole portion between the heel and the forefoot, except under one of the essential structural support elements, the bases of the fifth metatarsal, and except for an upper connecting layer of fabric or thin flexible top sole.

12. The shoe sole construction as set forth in claim 9 wherein an optional shoe sole support for the main longitudinal arch is retained.

13. The shoe sole construction as set forth in claim 9 wherein the forefoot is subdivided into some or all of its component essential structural support and propulsion elements, the individual heads of the metatarsals and the heads of the distal phalanges.

14. The shoe sole construction as set forth in claim 9 wherein said shoe sole includes one or more frontal plane slits through most or nearly all of said shoe sole.

15. The shoe sole construction as set forth in claim 9 wherein said naturally contoured side portion is substantially abbreviated along its sides to a plurality of essential support and propulsion elements, which include the base and lateral tuberosity of the calcaneus, the heads of the metatarsals, the base of the fifth metatarsal, and the head of the first distal phalange.

16. A shoe sole construction for a shoe, such as a street or athletic shoe, comprising:

a shoe sole with an upper foot-contacting surface that conforms substantially to the natural shape of the wearer's foot sole, including at least a portion of its sides, and a lower ground-contacting surface that substantially parallels said upper surface,

the sides of said shoe sole being substantially abbreviated for natural flexibility to some or all of those essential portions providing structural support about directly contacting the essential load-bearing structures of the wearer's foot, said essential structures including the base and lateral tuberosity of the calcaneus, the heads of the metatarsals, and the base of the fifth metatarsal and the head of the first distal phalange.

17. The sole construction as set forth in claim 16, wherein said sole will deform under load and flatten about just as does the human foot under load and wherein the material of said shoe sole is of such composition as to allow natural deformation about following that of the foot.

18. The sole construction as set forth in claim 16, wherein said sole is substantially abbreviated underneath the foot to all or part of those essential shoe sole portions providing structural support about directly contacting the load-bearing structures of the wearer's foot, including at least the heel and forefoot portions, however subdivided into elements, and the base of the fifth metatarsal, said essential shoe sole underneath portions being connected by a top layer of flexible materials, to provide natural flexibility substantially paralleling that of the wearer's foot.

19. The sole construction as set forth in claim 18, wherein an optional shoe sole support for the main longitudinal arch is retained.

20. The shoe sole construction as set forth in claim 16 wherein said shoe sole includes one or more frontal plane slits through most or nearly all of said shoe sole.

FIG. 1 (PRIOR ART)

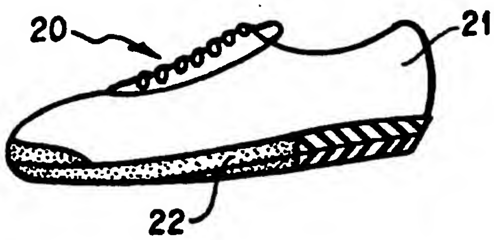


FIG. 2

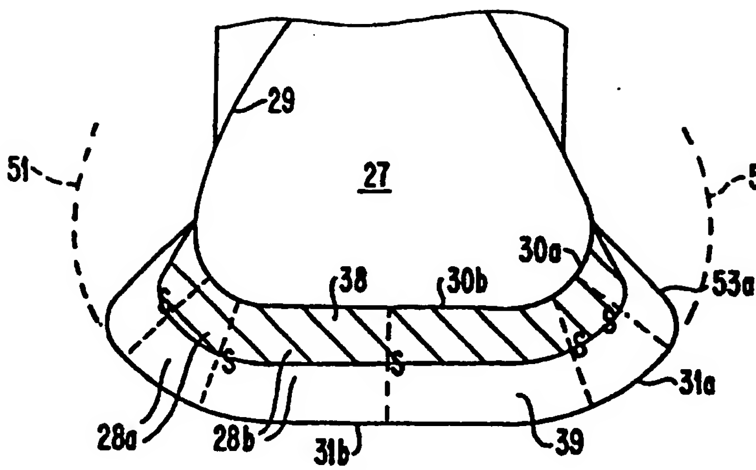


FIG. 3

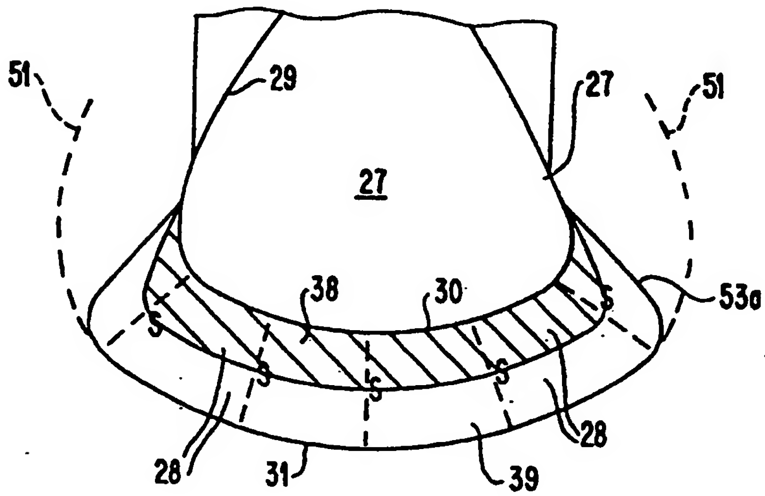


FIG. 4

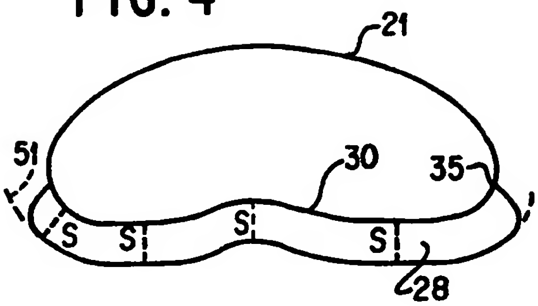


FIG. 5

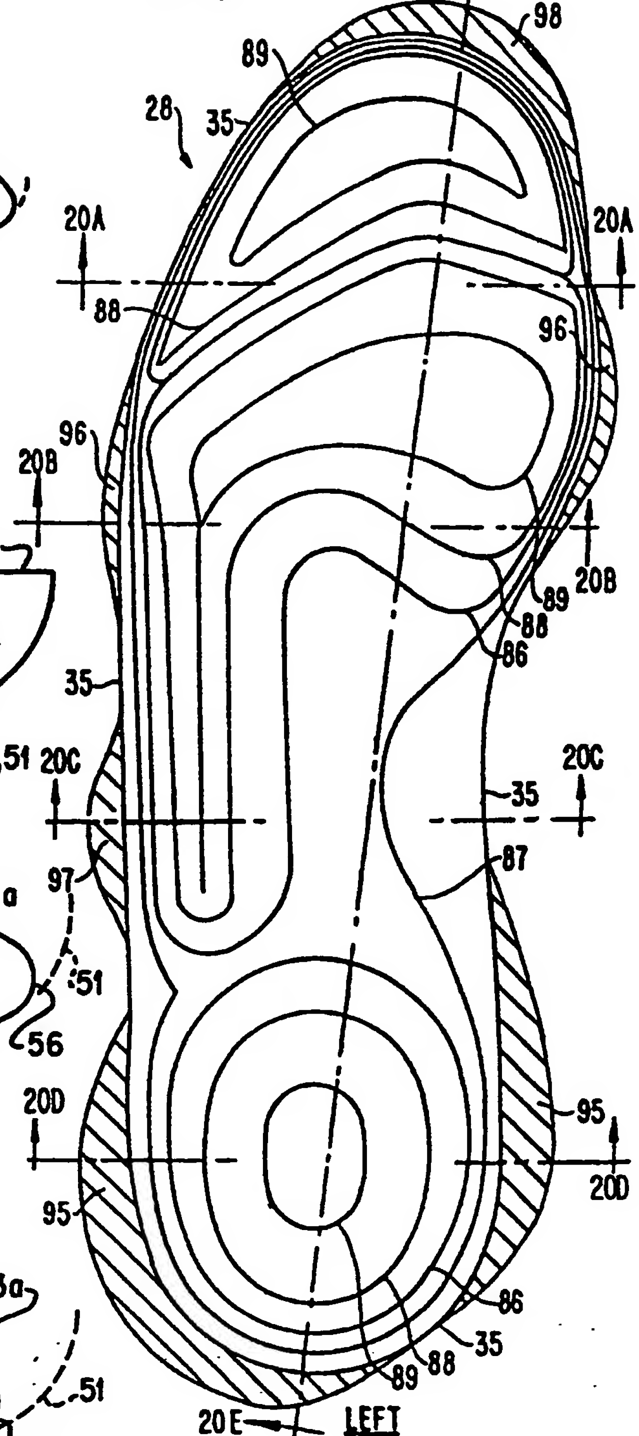


FIG. 6A

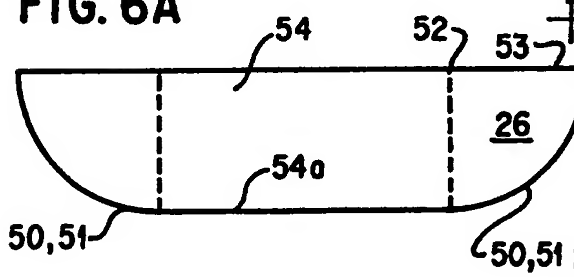


FIG. 6B

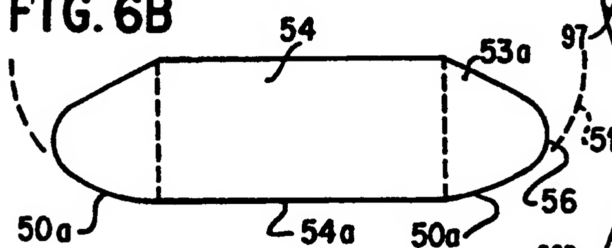


FIG. 6C

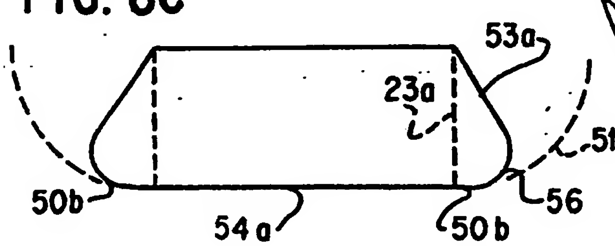


FIG. 7A

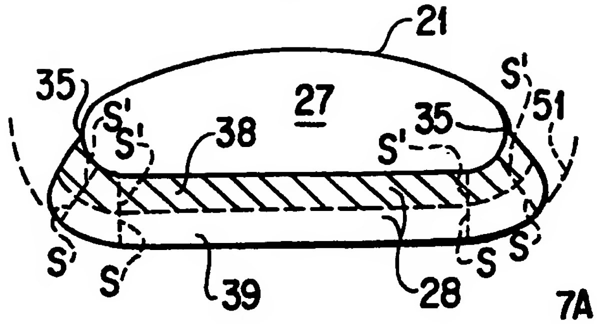


FIG. 7B

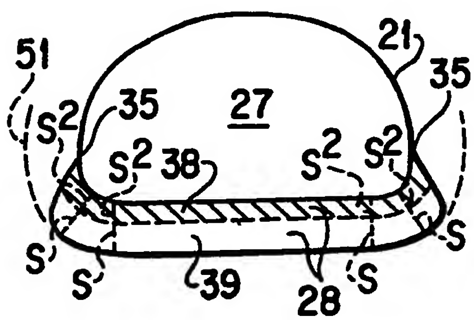
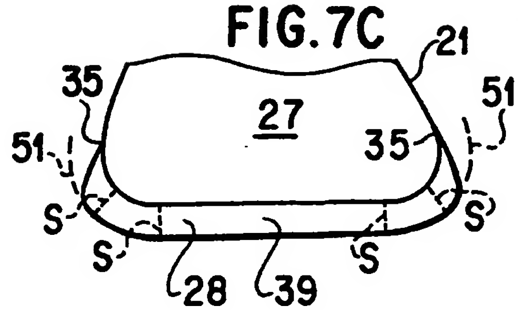


FIG. 7C



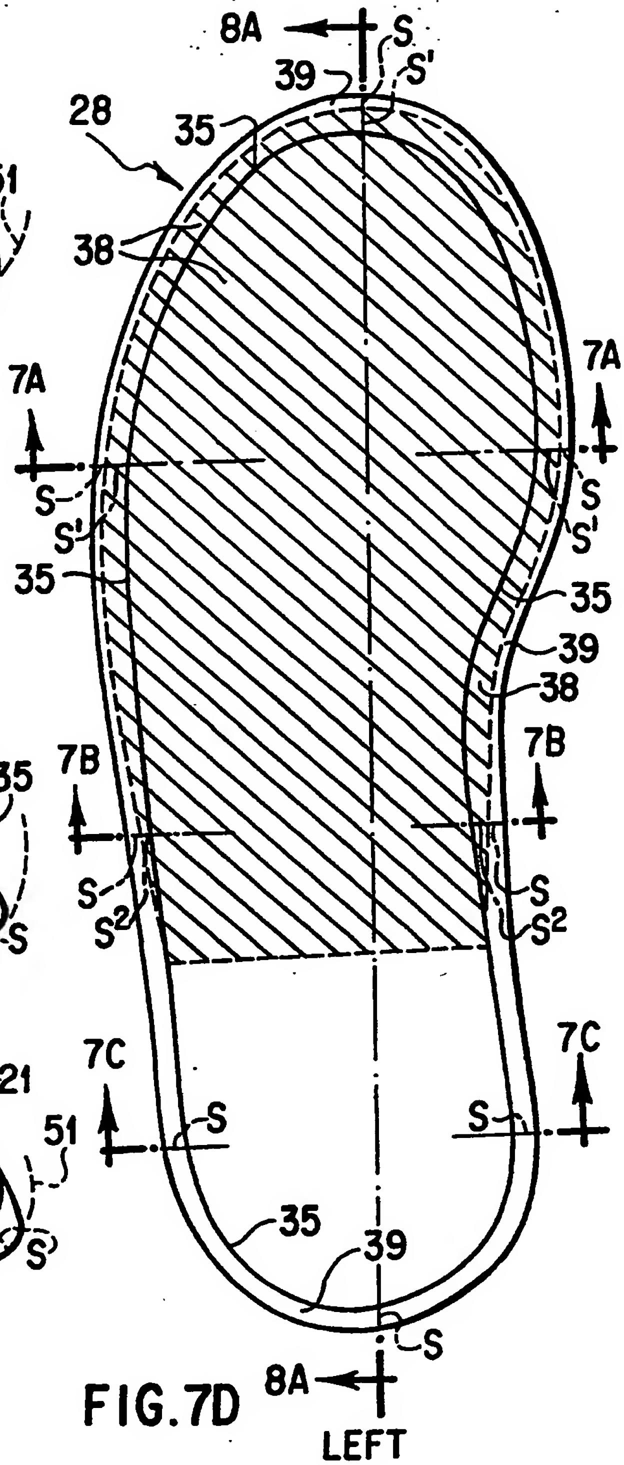


FIG. 7D

FIG.8A

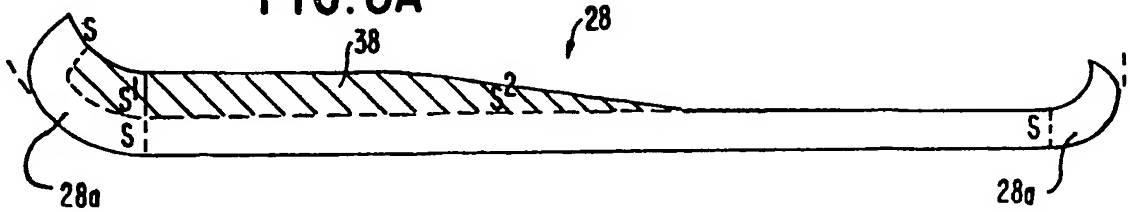


FIG.8B

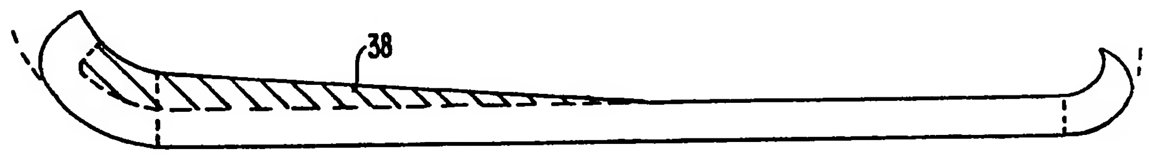


FIG.8C

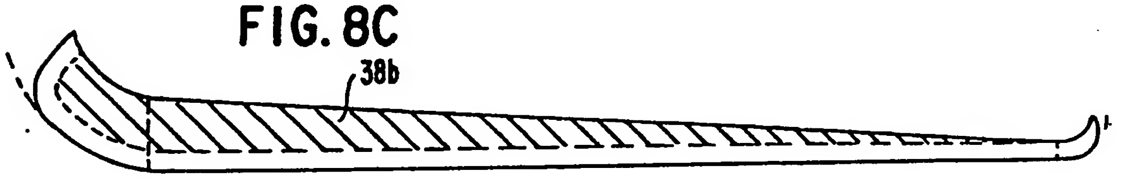


FIG.8D

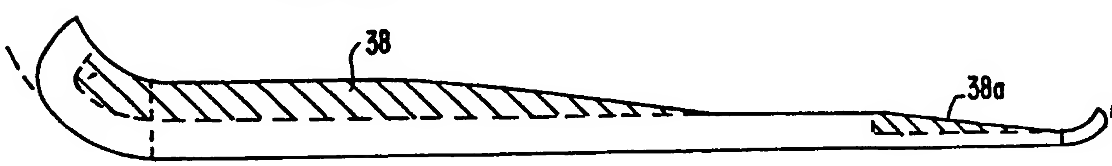
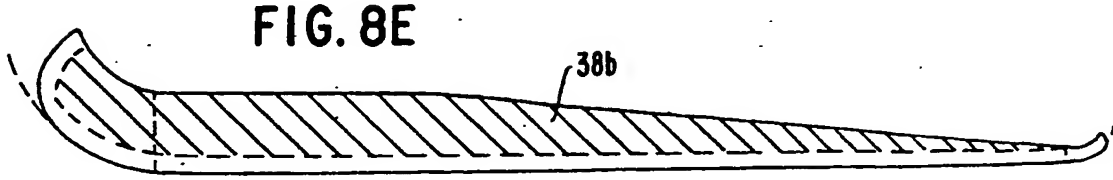


FIG.8E



SUBSTITUTE SHEET

FIG. 9A

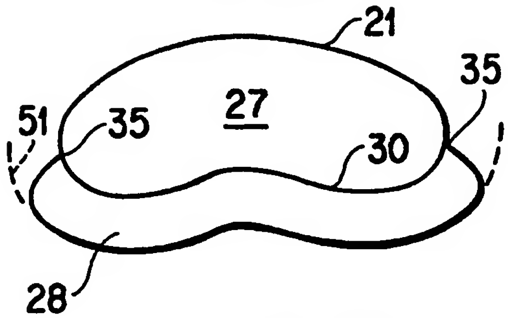


FIG. 9B

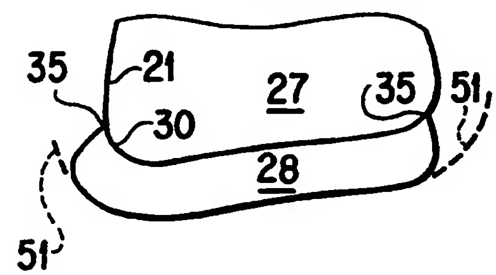
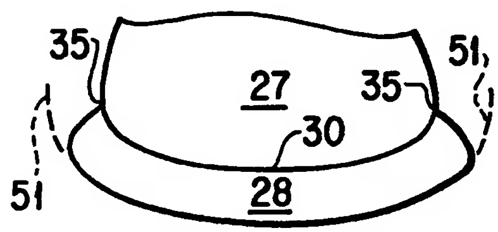


FIG. 9C



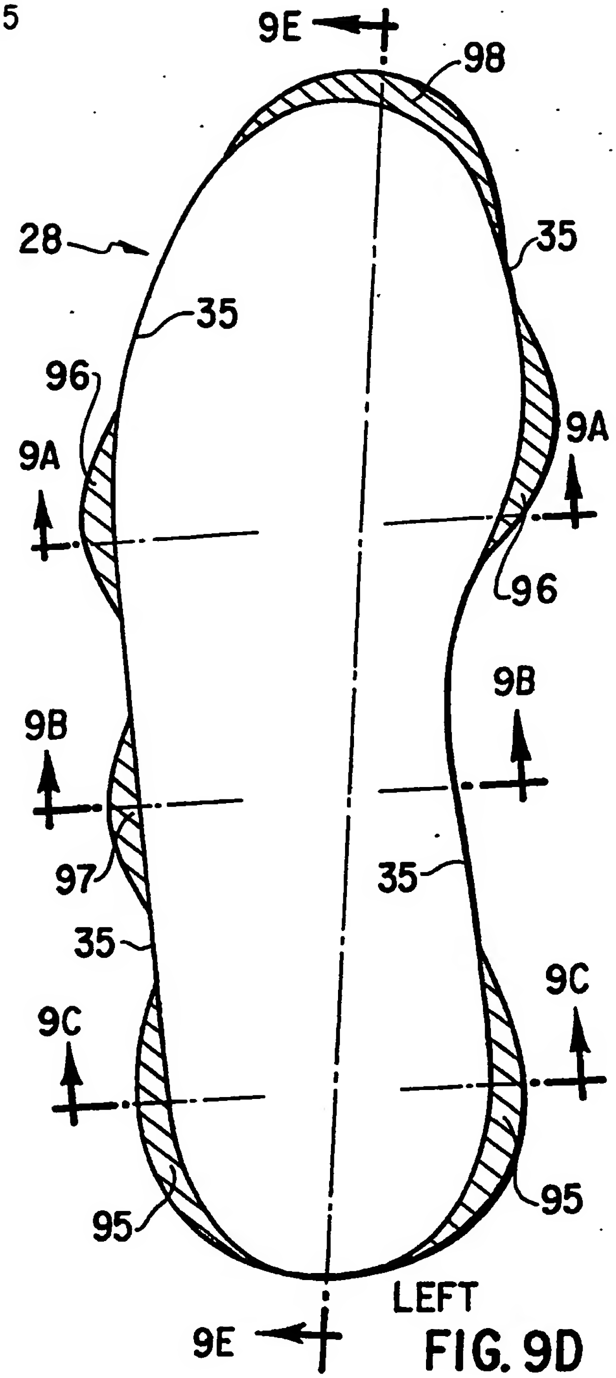
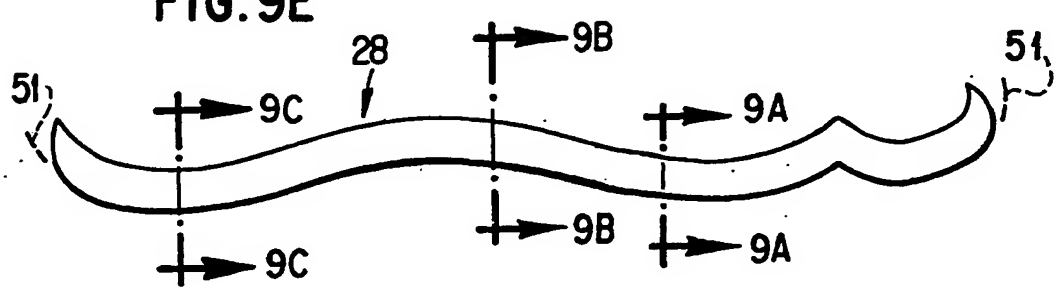


FIG. 9D

FIG. 9E



INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/00374

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): A43B 13/00

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
U.S. CL.	36/25R

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y,P	US, A 4,934,073 (ROBINSON) 19 JUNE 1990	1-5
Y	US, A 4,858,340 (PASTERNAK) 22 AUGUST 1989	9-20
Y	US, A 2,328,242 (WITHERILL) 31 AUGUST 1943	3,4,6-8,10,11, 11,20
Y	DE, A B,23,257 (BIANCHI) 17 MAY 1956	1-8

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
08 APRIL 1991	29 APR 1991
International Searching Authority	**Signature of Authorized Officer**
ISA/US	NGUYEN NGOC-HO INTERNATIONAL DIVISION THOMAS P. HILLARD Ngoc-Ho Nguyen for

Form PCT/ISA/210 (second sheet) (May 1986)